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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/521,356	08/08/2005	Milo Sebastian Peter Shaffer	082077-0314577	9306
909 7590 07/30/2010 PILLSBURY WINTHROP SHAW PITTMAN, LLP P.O. BOX 10500 MCLEAN, VA 22102				
EXAMINER				
VETTER, ROBERT A				
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/521,356

Applicant(s)

SHAFFER ET AL.

Examiner

ROBERT VETERE

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 13 May 2010.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1, 7-14, 16, 17, 20 and 23-25 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1, 7-14, 16, 17, 20 and 23-25 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO/SB06)
Paper No(s)/Mail Date 7/10.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____.
- 5) ☐ ~~Notes of Informal Patent Application~~
- 6) ☐ Other: _____.

DETAILED ACTION

Examiner's Comments

An amendment, amending claims 1, 16, 20, 23 and 24, was received on 5/13/10. Additionally, the last line of claim 1 refers to collecting the single walled nanoparticles. Based on the previous amendment, submitted 10/13/09, it is believed that this step is instead referring to collecting the single walled nanotubes and is being treated as such for the purposes of this action.

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1, 7-13, 16 and 24 rejected under 35 U.S.C. 103(a) as being unpatentable over Resasco et al. (US 6,333,016) in light of Weidenkaff et al. (Mat. Sci. Engr. C 19, pp. 119-123, 2002) and Kawakami et al. (US 2003/0086859).

Claims 1, 7-13 and 24: Resasco teaches a continuous (5:67) method of producing carbon nanotubes comprising the steps of: coating carrier particles, such as silica and alumina (5:30-35) with a thermally decomposable catalyst, such as a bimetal catalyst comprising, e.g., cobalt and nickel (4:52-65; 5:25-30), decomposing the metal salt catalyst to yield carrier particles coated with the catalyst (5:25-30), flowing a carbon-containing gas, such as methane, acetylene or CO, over the particles (5:50:61) to yield nanotubes (5:62-6:18), such as single walled nanotubes (6:7-18) and collecting the formed nanotubes (6:7-18).

What Resasco fails to teach is that the metal salt is formate or oxalate, that the particles are fluidized or that the catalyst precursor materials are decomposed in a non-reducing environment. Weidenkaff teaches a method of forming carbon nanotubes from a catalyst which is deposited on metal oxide carrier particles (Abst.) wherein the catalyst precursor is iron, cobalt or nickel oxalate and the catalyst is decomposed in air (i.e. non-reducing) to coat the carrier particles (p. 120, Col. 1) by

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suspending the catalyst coated carrier particles in a fluidized bed and exposing the particles to a carbon containing gas to yield nanotubes (p. 120, both columns). The selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have used nickel, iron or cobalt oxalate in the method of Resasco with the predictable expectation of successfully forming carbon nanotubes.

With respect to the limitation that the particles are collected by elution, Kawakami explains that elution is a technique known to those of ordinary skill in the art for collecting nanoparticles (§ 0162, e.g.). Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have collected the nanoparticles by elution because elution is well known in the art at the time of the invention as a means for collecting nanoparticles with the predictable expectation of success.

Claim 16: Weidenkaff also teaches that the oxalate is decomposed at 350°C in air (p. 120, col. 1).

3. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Resasco, Weidenkaff and Kawakami in light of Mandeville et al. (US 5,500,200).

Claim 14: Resasco teaches the use of alumina or silica as the carrier particles, but fails to expressly teach whether they are in the form of fumed powders. Mandeville teaches a method of forming carbon fibrils using fumed alumina as a carrier particle for the metal catalyst (3:22-43). The selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have selected fumed alumina particles as the type of alumina particle used in Resasco with the predictable expectation of success.

4. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Resasco, Weidenkaff and Kawakami in light of Tennent et al. (US 5,165,909).

Claim 17: Weidenkaff fails to teach that the iron oxalate used as the catalyst is decomposed at a temperature greater than 350°C. Tennent, however, teaches a method of forming carbon nanotubes

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wherein iron oxalate is used as the metal salt for forming the catalyst and wherein the iron oxide is decomposed at a temperature of less than 1200°C (8:1-10). In the case where the claimed ranges overlap or lie inside ranges disclosed by the prior art* a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976). Furthermore, a range can be disclosed in multiple prior art references instead of in a single prior art reference depending on the specific facts of the case. *Iron Grip Barbell Co., Inc. v. USA Sports, Inc.*, 392 F.3d 1317, 1322, 73 USPQ2d 1225, 1228 (Fed. Cir. 2004). Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have decomposed the iron oxalate in the combined method of Resasco, Weidenkaff and Kawakami at a temperature between 350-1200°C, such as between 600-1000°C with the predictable expectation of success.

5. Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Resasco, Weidenkaff and Kawakami in light of Resasco et al. (US 6,955,800, hereinafter "Resasco II").

Claim 20: Resasco II teaches a method of forming carbon nanotubes wherein catalytic particles are exposed to a carbon source gas to form the nanotubes (3:59-4:19). Resasco II explains that the carrier particles are impregnated with the catalytic metal compound. Resasco I, however, also teaches that zeolites can be used as the catalyst material (5:30-:35), which are highly porous and usually used to impregnate porous structures. The selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have impregnated the carrier particles with the catalyst, as taught by Resasco II, in the method of Resasco in order to have improved the economy of the nanotube forming process.

6. Claim 23 is rejected under 35 U.S.C. 103(a) as being unpatentable over Resasco, Weidenkaff and Kawakami in light of Kohlen et al. (US 6,290,775).

Claim 23: Resasco and Tennent II teach all the limitations of claim 23 except that the reaction occurs on an inclined surface. Kohlen explains that it is well known in the art that a fluidized bed reactors can be arranged vertically or at an angle (1:20-23). Thus, it would have been obvious to one of ordinary

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skill in the art at the time the invention was made to have arranged the fluidized bed reaction of the combined method of Resasco and Tennent II on an incline, as taught by Kohlen, with the predictable expectation of success because it is well known in the art to use an inclined fluidized bed for a reaction.

7. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Resasco, Weidenkaff and Kawakami in light of Xu et al. (US 5,973,444).

Claim 25: Resasco teaches that the carrier particles are silica, as discussed above, but fails to teach that the catalyst precursor is nickel formate. Weidenkaff teaches the use of nickel oxalate, as discussed above. Xu teaches that nickel formate can be used in the place of nickel oxalate as the catalyst precursor for forming carbon nanotubes (8:32-44). The selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have selected nickel formate in the place of nickel oxalate with the predictable expectation of success.

Response to Arguments

8. Applicant's arguments filed 5/13/10 have been fully considered but they are not persuasive.

Applicant first argues that Resasco '016 cannot render the claims obvious because Resasco '016 teaches that the catalyst precursors are decomposed in a reducing environment. This is not persuasive. While Resasco '016 teaches that the precursors are heated in a hydrogen environment, it teaches this step with respect to forming a cobalt catalyst from bis(cyclopentadienyl) cobalt. Weidenkaff, on the other hand, teaches that when forming a cobalt catalyst from cobalt oxalate, decomposition occurs in air (i.e. a non-reducing environment).

Applicant next argues that Weidenkaff should not be combined with Resasco '016 because Weidenkaff is directed to the formation of MWNTs and Resasco '016 is directed to the formation of SWNTs and the catalysts and methods used to form each of these nanotube types is different. This is not persuasive. Resasco and Weidenkaff both teach nickel and cobalt as the catalyst materials for the formation of single walled- and multiwalled nanotubes. The fact that Weidenkaff teaches a different precursor and means of decomposing the precursor will not have any bearing on the method of forming

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the SWNT because Resasco '016 also teaches that cobalt and nickel catalysts are used to form the SWNTs.

Applicant further argues that Kawakami does not teach using elution to collect the nanotubes. This is not persuasive. As applicant correctly points out, ¶ 0162 of Kawakami states: "Separately, the heat treated nanocarbon product (b) was treated with hydrochloric acid and then treated with nitric acid to elute and remove the nickel contained therein." By removing the nickel catalyst from the nanotubes by elution, Kawakami has isolated the nanotubes by elution.

Conclusion

9. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ROBERT VETERE whose telephone number is (571)270-1864. The examiner can normally be reached on Mon-Fri 9-6.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Cleveland can be reached on 571-272-1418. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Robert Vetere/
Examiner, Art Unit 1712

/Michael Cleveland/
Supervisory Patent Examiner, Art Unit 1712